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2009

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citation for published version (APA)

Koomen, E., & Hilferink, M. T. A. (2009). *Development of modelling tools for land use projections for large European areas*. (Interim technical report). VU.

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**European Commission
Directorate-General JRC
Joint Research Centre**

**DEVELOPMENT OF MODELLING TOOLS
FOR LAND USE PROJECTIONS FOR
LARGE EUROPEAN
AREAS**

**project reference: IES/H/2008/01/11/NC,
EC-JRC contract nr. 384282**

INTERIM TECHNICAL REPORT

May 15, 2009

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1 Project activities and achievements

1.1 Introduction

This interim technical report documents the course of the project, including organisational and administrative issues. It is compiled by the VU University Amsterdam and composed of previous progress updates and an account of the current state of affairs for which Object Vision has delivered important input. The report provides the chronological course of the project's activities and achievements.

Following the delivery of the 'Model design and revised workplan' (December 19, 2008) work concentrated on *building the basic model* and *preparing for a 100 metre grid version* based on the land-use data from JRC. As these data offer the starting point for the calibration of the model that will have to be delivered by week 36 ample attention was paid to *analysing the land-use data*. Each of these components will be discussed below.

1.2 Building the basic model

An initial model has been set up based on EURURALIS2.0 (Verburg et al., 2008; WUR/MNP, 2008) in cooperation with Wageningen University/Alterra. The EURURALIS land-use modelling application based on the dyna-Clue model has been reimplemented in the Land Use Scanner GeoDMS software. This reimplemented model will also be delivered to the DG. Environment as part of the work in contract ENV.G.1/SER/2008/0050. The basis model now includes the following components:

- collections of Nuts0 regions have been defined that mostly correspond to individual member states (the smallest member states have been added to large ones);
- around 60 Suitability/Conversion Factors on a 1 km grid, see Table 1;
- 6 endogenous (suitability and demand driven) land-use types, 4 exogenous (conversion matrix driven) land-use types;
- demand is completely specified, meaning that no bandwidth is incorporated in the claims;
- simulation now takes place on a 1km grid per (collection of) Nuts0 regions in 1 year steps.

Chronologically, the following model-building activities have been carried out. In December 2008 until February 2009 we have focussed on the reproduction of the EURURALIS/dyna-Clue model by a model script for the Land Use Scanner/GeoDMS for Belgium/Luxembourg and France. In February we found the results for the simulations until 2030 satisfactory. In March 2009 we have built a European database with 60 suitability factors on a European wide 1km grid. See Figure 1 for an example. Initial data-transfer problems have recently been solved and in April 2009 we reproduced all available EURURALIS datasets within the Land Use Scanner. These datasets, including the regression results will remain an important building block for the JRC model. At this moment we are busy specifying the B1 scenario specification for 24 collections of Nuts0 regions. Figure 2 shows the simulation results for one Nuts0 region by way of example. The specification of the A2 scenarios is available too, but application awaits a shift from nuts0 specific data to using tiles from European wide data.

To make further model development possible, the following software adaptations were made:

- Jan-Feb 2009: preparation for Logistic Regression on large datasets

- March 2009: reading tiles from ascii-grids
- March 2009: preparation for tiled calculations
- April 2009: reading numeric specification files to process EURURALIS parameter files.

Table 1 Suitability factors made available from EURURALIS on a 1km grid

ID	Name	Description	Coverage
0	REGION	ZERO	ALL
1	ACCESS1_06M	Timecost to cities > 100.000 (s)	missing Turkey and (Cyprus and Malta are reasonably ok)
2	ACCESS2_06M	Timecost to cities > 500.000 (s)	missing Turkey and Cyprus and Malta
3	ACCESS3_06M	Timecost to ports > 15.000 kTon/year	missing Turkey and Cyprus and Malta
4	ACCESS4_06M	Timecost to cities > 650.000 (s)	missing Turkey and Cyprus and Malta
5	ACCESS5_06M	Airline distance to nearest road level 0,1 (m)	missing Turkey and Cyprus and Malta
6	ACCESS6_06M	Timecost to major airports (s)	missing Turkey and Cyprus and Malta
7	ACCESS7_06M	Timecost to airports & ports (s)	missing Turkey and Cyprus and Malta
8	claycont_06pc	soil clay content (%)	missing Iceland, Turkey, Cyprus and Malta
9	ddw_shortage	water deficit growing season	ALL
10	dem_final	elevation	ALL
11	envmap01	ALN: Alpine north	missing Iceland, Turkey, Cyprus
12	envmap02	BOR: Boreal	missing Iceland, Turkey, Cyprus
13	envmap03	NEM: Nemoral	missing Iceland, Turkey, Cyprus
14	envmap04	ATN: Atlantic north	missing Iceland, Turkey, Cyprus
15	envmap05	ALS: Alpine south	missing Iceland, Turkey, Cyprus
16	envmap06	CON: Continental	missing Iceland, Turkey, Cyprus
17	envmap07	ATC: Atlantic central	missing Iceland, Turkey, Cyprus
18	envmap08	PAN: Pannonian	missing Iceland, Turkey, Cyprus
19	envmap09	LUS: Lusitanian	missing Iceland, Turkey, Cyprus
20	envmap10	ANO: Anotolian	missing Iceland, Turkey, Cyprus
21	envmap11	MDM: Mediterranean mountains	missing Iceland, Turkey, Cyprus
22	envmap12	MDN: Mediterranean north	missing Iceland, Turkey, Cyprus
23	envmap13	MDS: Mediterranean south	missing Iceland, Turkey, Cyprus
24	EUAC120_2006	# of people that reach a location from their home within 120 minutes	EU15
25	EUAC30_2006	# of people that reach a location from their home within 30 minutes	EU15
26	EUAC60_2006	# of people that reach a location from their home within 60 minutes	EU15
27	Geomorf01	Average height difference of 0-20 m: flat	missing Turkey
28	Geomorf02	Average height difference of 20-80 m: rolling	missing Turkey
29	Geomorf03	Average height difference of 80 - 200 m: hilly	missing Turkey
30	Geomorf04	Average height difference of 200 - 400 m: mountainous	missing Turkey
31	Geomorf05	Average height difference of > 400 m: very mountainous	missing Turkey
32	IL_2006	Presence of an impermeable layer within the soil profile	missing Iceland, Turkey, Cyprus, former Yugoslavia
33	landsc_06	ORNL LandScan (population) derived from World02	ALL
34	mean_temp_06	mean yearly temperature	ALL
35	Peat_06	peat 1/0	missing Iceland, Turkey, Cyprus
36	poppot_1mi06	population potential with 12.5 km inflection point (rounded to 1 million)	missing Iceland, Turkey
37	poppot_log06	log (population potential with 12.5 km inflection point)	missing Iceland, Turkey
38	poppot_sum06	population potential with 12.5 km inflection point	missing Iceland, Turkey
39	rain_wc_5m	accumulated rainfall March-July	ALL
40	rain_wc_yr	accumulated rainfall per year	ALL

ID	Name	Description	Coverage
41	Salinity	saline soils	missing Iceland, Turkey, Cyprus and Malta
42	slope_final	slope	ALL
43	soildepth_06	soil depth	missing Iceland, Turkey, Cyprus, Malta, Switzerland, Yugoslavia
44	stoniness100	stoniness	missing Iceland, Turkey, Cyprus and Malta
45	Swap	soil water available to plants	EU25+2 MINUS nor/swe/fin and Cyprus and Malta
46	sz_landsc_rur	if landsc_06 >100, 100, landsc_06	EU25+2 MINUS nor/swe/fin and Cyprus and Malta
47	t_min0_1000	Count of months a year with average temperature < 0 degrees C	missing Iceland, Turkey, Cyprus
48	t_plus15_1000	Count of months a year with average temperature > 15 degrees C	missing Iceland, Turkey, Cyprus
49	wr_06	Soils with water restriction (too much water)	missing Iceland, Turkey, Cyprus AND and Malta
50	ac_cst_c_m06	distance to coast for Malta an Cyprus	only Cyprus and Malta
51	ac_pnts_c_m06	distance to city/airport/port for Malta an Cyprus	only Cyprus and Malta
52	X1	Natura2000 (0); outside (1)	EU27 for other countries incomplete/unreliable depending on base data
53	X2	Succession arab_aban >> (semi)nat in A1	EU27 for other countries incomplete/unreliable depending on base data
54	X3	Succession grass_aban >> (semi)nat in A1	EU27 for other countries incomplete/unreliable depending on base data
55	X4	Succession (semi)nat >> forest in A1 and A2	EU27 for other countries incomplete/unreliable depending on base data
56	X5	Succession arab_aban >> (semi)nat in A2	EU27 for other countries incomplete/unreliable depending on base data
57	X6	Succession grass_aban >> (semi)nat in A2	EU27 for other countries incomplete/unreliable depending on base data
58	X7	Succession arab_aban >> (semi)nat in B1	EU27 for other countries incomplete/unreliable depending on base data
59	X8	Succession grass_aban >> (semi)nat in B1	EU27 for other countries incomplete/unreliable depending on base data
60	X9	Succession (semi)nat >> forest in B1 and B2	EU27 for other countries incomplete/unreliable depending on base data
61	X10	Natura2000 + erosion sensitive (0); outside (1)	EU27 for other countries incomplete/unreliable depending on base data
62	X11	Succession arab_aban >> (semi)nat in B2	EU27 for other countries incomplete/unreliable depending on base data
63	X12	Succession grass_aban >> (semi)nat in B2	EU27 for other countries incomplete/unreliable depending on base data

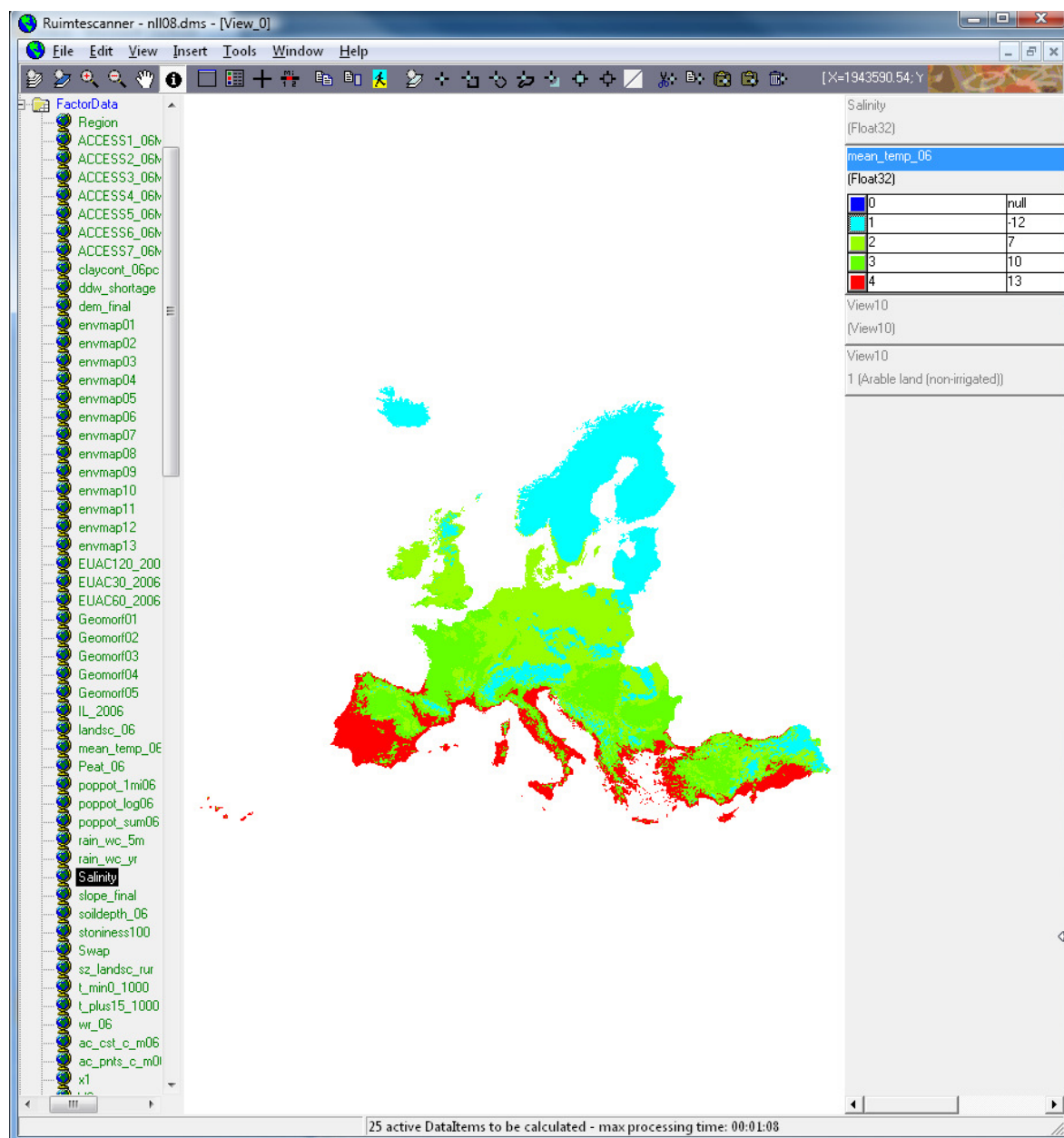


Figure 1 Screenshot of the model interface showing a suitability factor: mean annual temperature in 2006.

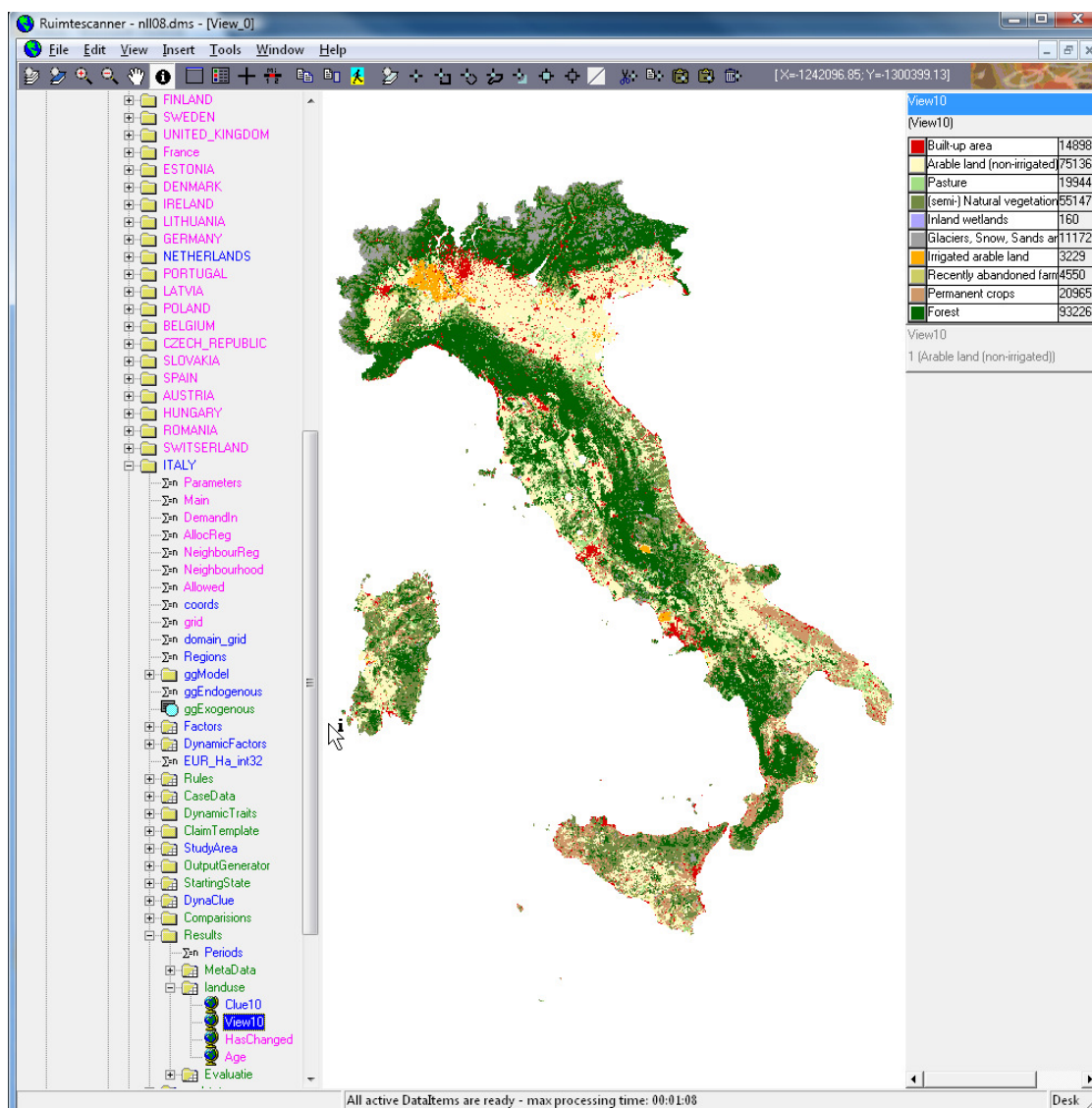


Figure 2 Screenshot of the model interface showing simulation results for Italy.

1.3 Preparing for a 100m grid version

As land-use base data we selected CLC 2000 because the 2006 version will not be available in time. Available more detailed data will be incorporated where possible. In order to do so, JRC has provided two land-use base maps (1990 and 2000) based on CLC1990 and CLC2000. See Section 1.4.2 for more information on these data sets. The data were delivered March 20 and April 7 respectively, based on specifications provided by the contractor in terms of resolution, extent, typology projection et cetera. Following this delivery the development of the 100m grid version of the model could start.

The data has first been processed for incorporation in the GeoDMS environment. These data have also been made available in Nuts0 zones for further analysis. At this moment transition matrices are being constructed that show the land-use changes between the two time steps. This analysis is a first step towards a calibration of the 100m grid model.

Some additional 100m grid data sets have also been collected: water depths for the 100-year return period floods under current climate conditions and detailed (90m resolution) elevation data. More thematic data will be delivered by JRC in the near future.

Thematic resolution

As thematic resolution (land-use typology) the set of land-use types indicated in the table below is selected. JRC has expressed the wish that as much urban land-use types are simulated as possible. The model will have the flexibility to introduce new or more refined land-use types should this be deemed necessary in future especially when higher resolution data (e.g. from the MOLAND database or acquired from regional institutions) are available. The land-use typology has, furthermore, been harmonized with the land-use model that will be developed for EC-DG Environment. This has led to the inclusion of several natural land-use types that allow for more specific allocation rules and the assessment of changes in biodiversity.

In addition to this Corine Land Cover (CLC) based typology it is possible to include additional land-use types in model simulation to account for anticipated developments related to, for example, land for biofuels or recently abandoned pasture land. The latter land-use type allows the simulation forest regeneration. The EC-DG environment land-use modelling implementation project will show the potential of such additional land-use types and may be included in the JRC model, provided that EC-DG Environment approves and this can be realized within the time frame of our project.

It is apparent from Table 2 that the land-use typologies in the JRC and DG Environment projects are different. For clarity's sake these differences are shortly discussed below:

- The JRC-model has a finer resolution (100m versus 1km) and a partial different origin (see Section 1.4.2)
- The random reassignment of the CLC-classes 2.4.2 and 2.4.3 will cause local differences. The initial reassignment for EURURALIS was also done randomly, but will of course have led to a different selection of grid cells.
- The JRC-model does not (yet) distinguish the additional abandoned farmland (DG Environment class 7) and bio fuel crops (9) classes.
- DG Environment separates Salines (13) from the other coastal wetlands (salt marshes and intertidal flats). The latter are combined with all sweet and salt water classes (14). In this project we have chosen to distinguish several types of water to allow for more visualisation and analysis options. These land-use types remain static, however, in simulation; their patterns will not change after simulation.

Table 2 Thematic resolution of the JRC model and their relation with the DG Environment model and initial Corine Land Cover types.

JRC ¹	DG.Env ²	CLC-class	CLC-code	Name	Simulated
0	0	1.1.1	1	Continuous_Urban_fabric	Yes
1	0	1.1.2	2	Discontinuous_Urban_fabric	Yes
2	0	1.2.1	3	Industrial_or_commercial_units	Yes
3	0	1.2.2	4	Road_and_rail_networks	No
4	0	1.2.3	5	Port_areas	No
5	0	1.2.4	6	Airports	No
6	0	1.3	7/8/9	Mine_dump_and_construction_sites	Yes
7	0	1.4	10/11	Artificial_non_agricultural_vegetated_areas	Yes
8	1	2.1.1/ 2.4.2p(50%)/ 2.4.3p(25%)	12/20p/21p	Arable_land (non-irrigated)	Yes
9	6	2.1.2/2.1.3	13/14	Arable_land (irrigated)	Yes
10	8	2.2/2.4.1/2.4.4	15/16/17/ 19/22	Permanent_crops	Yes
11	2	2.3/ 2.4.2p(50%)/ 2.4.3p (45%)	18/20p/21p	Pastures	Yes
12	10	3.1	23/24/25	Forests	Yes
13	3	3.2.1/3.2.3/ 3.2.4/2.4.3p (30%)	26/28/29/ 21p	Semi natural vegetation	Yes
14	15	3.2.2	27	Heather and moorlands	No
15	12	3.3.1	30	Beaches, dunes and sands	No
16	11	3.3.2/ 3.3.3/3.3.4	31/32/33	Sparsely vegetated areas	No
17	5	3.3.5	34	Glaciers and snow	No
18	4	4.1	35/36	Inland_wetlands	No
19	13/ 14	4.2	37/38/39	Coastal_wetlands	No
20	14	5.1	40/41	Inland_waters	No
21	14	5.2	42/43/44/ 50	Marine_waters	No

Notes:

¹The JRC column shows the individual land-use types distinguished in the model developed for JRC.

²For reference purposes the land-use types of the model developed for DG. Environment are included in the second column. These correspond to the EURURALIS application.

The 'p' after certain Corine Land Cover classes and codes denotes that only part of this type is to the mentioned class. This partial assignment has been done randomly within the quantitative constraints mentioned here. So a random selection of 50% of the grid cells belonging to CLC-class 2.4.2 has been assigned to arable land, the other half has been assigned to pastures. A random selection was chosen as that corresponded well with the actual land-use patterns that can be observed from aerial photographs (verbal comment Peter Verburg , 2009)

Figure 3 and Figure 4 provide examples of the incorporation of the 100m grid data in the DMS environment. The former shows the land-use typology of the JRC-project. The latter that of the DG Environment project.

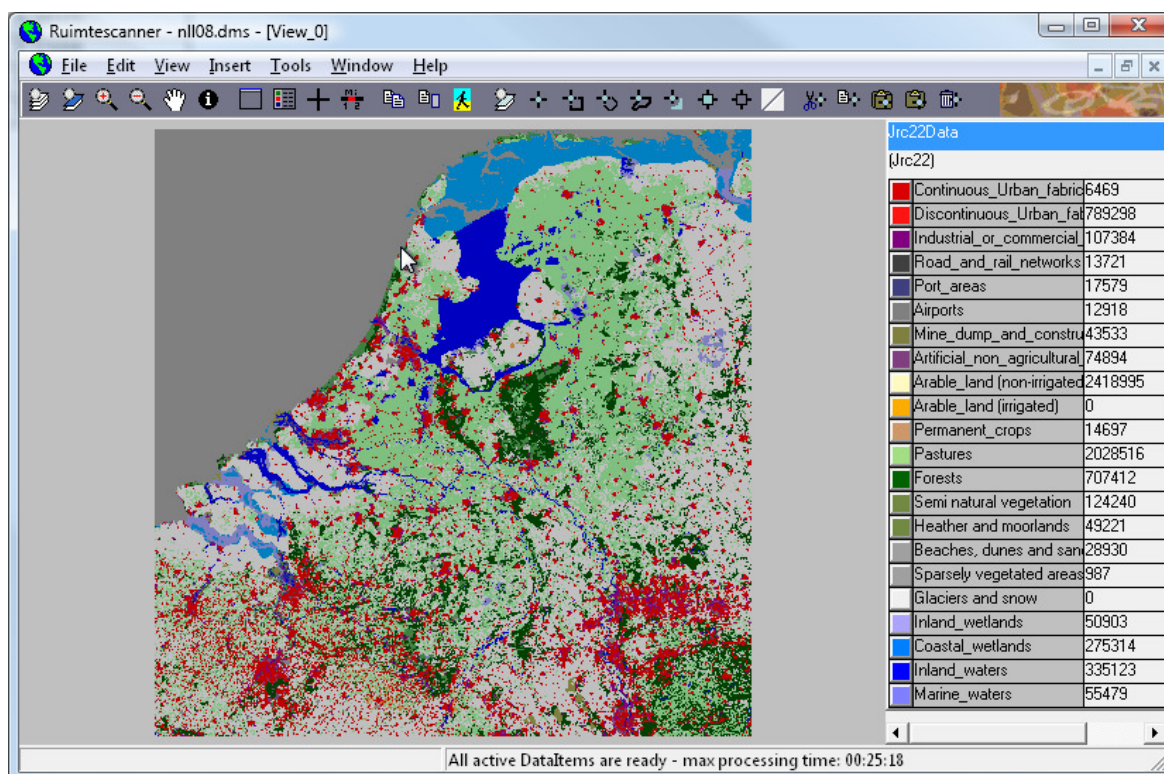


Figure 3 The 100m CLC grid data inserted in the GeoDMS environment shown as the 22 land-use types defined for JRC.¹

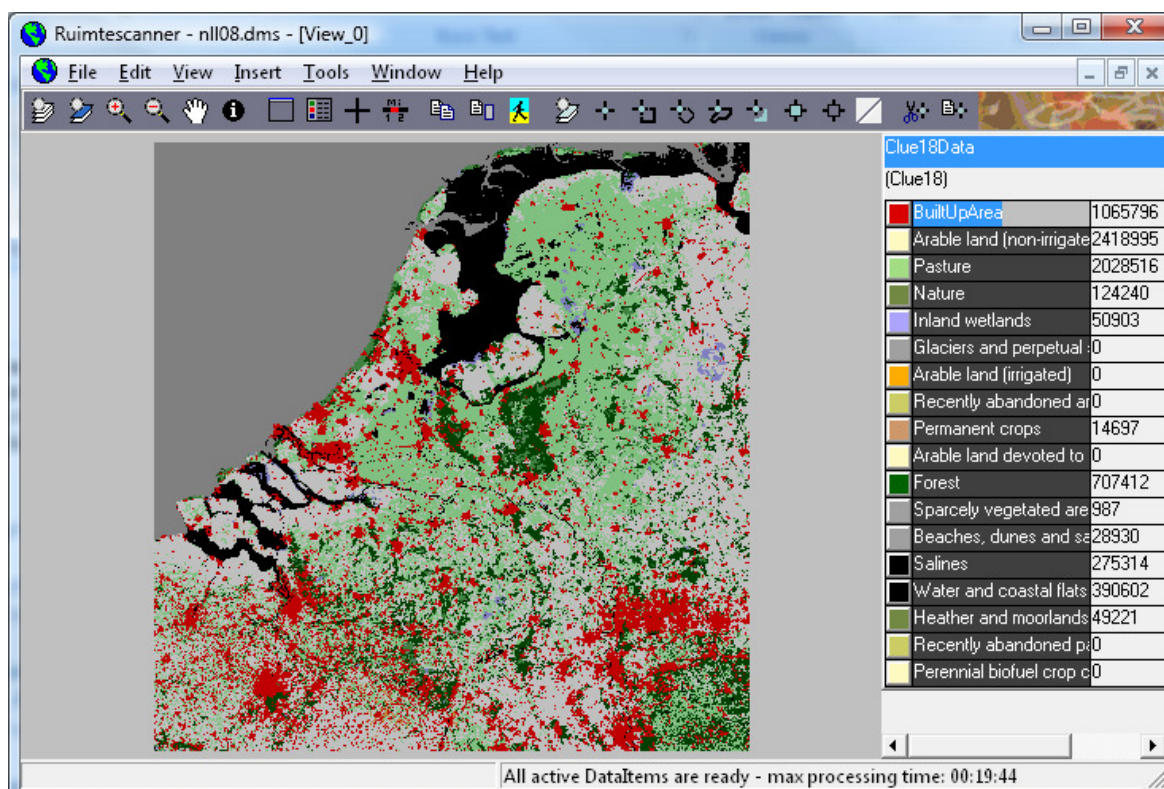


Figure 4 The 100m CLC grid data inserted in the GeoDMS environment shown as the 18 land-use types defined for DG Environment

¹ CLC50 (Sea and Ocean) will be shown as (marine) waters in final model versions.

1.4 Analysing the land-use data

To get insight in the overall quality of the Corine Land Cover (CLC) data a two separate analyses were performed:

- comparison of the total per-country change in the CLC1990 and 2000 data and the CLC-change dataset available from EEA
- per country detection of changes in the 1990-2000 land-use data obtained from JRC

1.4.1 Comparison of CLC data from EEA

The Coordination of Information on the Environment (CORINE) Programme implemented by the European Commission has resulted in a land cover data set (CLC1990) for a large part of the European territory. Following the need for an update of this data set EEA and the Joint Research Centre (JRC) launched the IMAGE2000 and CLC2000 Project (I&CLC2000). The CLC1990 and CLC2000 data sets offer the most detailed and consistent land cover information available, distinguishing areas with a minimum size of 25 ha and a minimum width of 100 metres. Appendix 2 lists the countries for which the data sets are available and also indicates the range of years of the satellite images that were used to create these datasets. The appendix makes clear that the actual years the data refer to, deviate up to 5 years from the reference years 1990 and 2000. Furthermore, substantial differences exist between the different countries, especially for 1990. The origin and quality of these data sets is described extensively elsewhere (e.g. Feranec et al., 2007; JRC, 2005).

We compared the improved CLC1990 and CLC2000 data sets (both version 9/2007) to derive the changes between these years. Subsequently, we compared the obtained changes with the CLC-change data set that is provided by EEA to facilitate an easy interpretation of land-cover changes. The CLC-change data set, amongst others, applies minimum dimensions (5 hectares for extensions, 25 hectares for isolated new areas) to the changes to be included. It may thus differ from our comparison of CLC1990 and 2000. For this comparison we used the original version of the CLC data without any reclassification. So any change from one of the 44 land cover subtypes to another subtype was considered.

Table 3 lists the amount of change observed between the CLC1990 and CLC2000 data sets. It compares the amount of change observed in a direct comparison of the two in ArcGIS and the amounts of change in the CLC-change dataset provided by EEA. In an additional spatial analysis we focussed on the differences between these two change observations. For each changed location (either in our comparison or the CLC-change data set) we compared the 1990 and 2000 land cover. When the land cover in either of the two years differed between the two data sets the change was classified as being different. These 'different changes' thus include locations that only change in one of the two approaches or reflect changes that refer to a different initial or final land cover.

For most countries the amount of change according to the two approaches does not differ more than 5%. A few exceptions exist however. These are mainly found in countries bordering one or more countries for which no CLC1990 data set exists. The land cover in these border zones is often classified differently in 1990 and 2000, possibly because of the correction process related to the creation of the CLC2000 data set in the neighbouring countries. Especially striking are the many small different changes throughout Hungary and, to a lesser extent, Belgium, that seem to be related to the minimum mapping areas applied in the creation of CLC-change data. The issue of underestimation of small changes (<5 ha) and isolated changes in the range of 5 to 25 hectares is also noted in CLC documentation (e.g. JRC, 2005: p. 121).

From this analysis we conclude that it possible to rely on the original CLC1990 and CLC2000 data sets to analyse land cover changes. Using this original data may even offer the advantage of being able to include the smallest discernable changes.

Table 3 Total amount of change between CLC1990 and CLC2000 per country based on a direct comparison and the CLC-change dataset. The following two columns indicate the differences between the two approaches.

Country	change CLC 1990/2000 [ha]	CLC-change [ha]	different changes [ha]	idem [%]	remarks
Albania	n.a.	n.a.	n.a.	n.a.	No CLC1990
Austria	38063	36335	1886	5%	
Belgium	59353	53475	6644	11%	Many small changes
Bosnia-Herzegovina	n.a.	n.a.	n.a.	n.a.	No CLC1990
Bulgaria	128714	122041	7309	6%	
Croatia	120950	107316	22729	19%	Borders country without CLC1990
Cyprus	n.a.	n.a.	n.a.	n.a.	No CLC1990
Czech republic	516285	510486	6751	1%	
Denmark	55310	54733	678	1%	
Estonia	123493	120070	5671	5%	
Finland	n.a.	n.a.	n.a.	n.a.	No CLC1990
France	1111948	1111224	1536	0%	
Germany	854206	852395	2140	0%	
Greece	312812	268061	55460	18%	Borders countries without CLC1990
Hungary	380957	415053	134909	35%	Many small changes throughout country
Ireland	558181	556331	1978	0%	
Italy	393658	393289	1208	0%	
Latvia	164420	156669	10948	7%	Borders countries without CLC1990
Liechtenstein	n.a.	n.a.	n.a.	n.a.	No CLC1990
Lithuania	261665	251429	10429	4%	
Luxembourg	4485	4306	359	8%	Many small changes
Macedonia (FYROM)	n.a.	n.a.	n.a.	n.a.	No CLC1990
Malta	n.a.	n.a.	n.a.	n.a.	No CLC1990
Montenegro	20258	2661	18134	90%	Borders countries without CLC1990
the Netherlands	158566	158251	1290	1%	
Poland	256655	255031	2207	1%	
Portugal	998494	963327	36140	4%	
Romania	303755	310166	21090	7%	Borders countries without CLC1990
Serbia	101122	83007	40062	40%	Borders countries without CLC1990
Slovak republic	201230	200305	1460	1%	
Slovenia	3189	2434	878	28%	Borders country without CLC1990
Spain	2365971	2354666	13310	1%	
Sweden	n.a.	n.a.	n.a.	n.a.	No CLC1990
United Kingdom	n.a.	361733	n.a.	n.a.	No CLC1990, CLC-change exists

1.4.2 Change detection in the 1990 and 2000 JRC data

The data sets provided by JRC are based on the CLC data sets, but some additions have been made to extend its coverage. The following data sets, all with a 1km resolution, were used to add the missing 1990 information for the countries listed in Appendix 2 (except Cyprus that still lacks 1990 data), and the 'white spots' enclosed in the CLC2000 territory (Switzerland, Norway, Kalinagrad, Kosovo and Andorra):

- USGS Global Land Cover Characterisation and PELCOM land cover for 1990;
- USGS Global Land Cover Characterisation, PELCOM land cover and the GLC200 data set for 2000.

The exact years the inserted information relates are not known. The coarser data were sub-sampled to obtain a 100 metre grid version. JRC has not yet ingested data at higher

resolution than CLC (we need to discuss how this can be done). Some regions are ready but not included in the data that was delivered. The data for Iceland (only 2000) and Turkey (1990 only western part and 2000 full territory) are omitted as they are incomplete and would call for a serious extension of the model coverage. This pan-European land cover data set is quite unique and the result of the work of JRC. The data will, therefore, only be used within our common project. It offers a good basis for a joint publication.

Before the JRC data can be analysed a number of processing steps is necessary:

- importing the ascii grids in the GeoDMS environment;
- reclassifying the data to obtain the 22 land-use types listed in Table 2;
- exporting the data as ascii grids for a series of Nuts-0 regions that correspond to (combinations) of countries.
- importing the data in ArcGIS to tabulate areas and analyse changes between the years.

The JRC data are used to detect land cover changes in the 1990-2000 period. This change analysis is an initial step in the calibration of the model. The calibration aims to inform the model of observed past changes to allow for the simulation of potential future developments. The calibrated model will provide a trend-based extrapolation of past land-use changes to simulate a land-use map of the near future (2010 or 2020). It will be based on the following elements:

- 1) an estimated amount of change for each of the 11 simulated land-use types (see Table 2);
- 2) a specification of the most likely locations for these land-use types in the future.

To provide input for the estimated amount of change, first the total amounts of land for each of the 11 land-use classes are retrieved for each year. From these general statistics the increase or decrease in the amount of land for each land-use type can be inferred. This is then divided by the actual time difference of the land-use base data (see Appendix 2) to obtain a yearly change rate that can be used to define a future demand for 2010 or 2020. An example of this approach is provided for Spain in Table 4.

The specification of the most probable future locations for the simulated land-use types is based on a transition analysis that shows exactly which locations change from one land-use type to another. This analysis will also show the most important trends in land-use change (e.g. reforestation on non-irrigated land, or urbanisation on pastures). A statistical analysis using multinomial logit regression will then be used to link the observed changes to spatial dataset representing known driving forces.

In April the transition matrices for all countries have been constructed and analysed. This revealed a number of unlikely conversions that after a lengthy search process proved to be related to a slight shift in the initial JRC data. Following the reprojection and/or conversion from vector to raster format the exact locations of the 1990 and 2000 grids shifted slightly (about 1 pixel) southwards. JRC has been informed about this problem and they very swiftly provided new, corrected grids. These are currently being processed. It is likely, however, that this will cause a delay in the calibration of the model and the delivery of the second version of the model.

Table 4 Total amount of land (ha) and observed changes for the relevant land-use types in JRC1990 and JRC2000 in Spain.

		JRC1990	JRC2000	Total change	Change/year¹
1	Continuous urban fabric	2765	2899	134	10
2	Discontinuous urban fabric	5850	6837	987	73
3	Industrial or commercial units	1243	1861	618	46
4	Mine dump and construction sites	931	1443	512	38
5	Artificial non agricultural vegetated areas	316	509	193	14
6	Arable land (non-irrigated)	175955	171322	-4633	-343
7	Arable land (irrigated)	23059	26200	3141	233
8	Permanent crops	80254	81709	1455	108
9	Pastures	66167	65497	-670	-50
10	Forests	155203	155379	176	13
11	Semi natural vegetation	158613	156749	-1864	-138
12	Other nature ²	31924	31284	-640	-47
13	Infrastructure ²	398	469	71	5
14	Water ²	4727	5228	501	37
	Total	707405	707386	-19	

Notes:

¹The yearly change is based on the average difference between the actual years the land-use date refer to.

²These land-use classes will not be simulated in the model and consist of an aggregation of the land-use types listed in Table 2.

This table is based on an initial delivery of the land-use data that contains a small error. The final results will most likely differ slightly from figures presented here.

2 Summary

The project is making good progress. The basic model is now available and has been delivered to JRC. The creation of 100 metres grid version is underway. The calibration is facing a delay due problems within the base land-use data provided by JRC. This problem is currently being solved. Below is a description of the planning of the remainder of the project.

2.1 Project planning

The following activities are foreseen for the remainder of the project.

Joint Activities for JRC and DG Env:

- 15 May: Reading simulation data from European grids and not from region specific files.
- 30 May: link from GTAP/Image data to the regional demands.
- June: implementation of various indicators.

JRC Specific Activities:

- May: JRC specific land use classification as derived from CLC (including more types of urban land use);
- June/July/August: Design, implementation and documentation of the scenario/case definition and data ingestion tool;
- September: Finalisation and documentation of the Logistic Regression / Calibration procedures;
- September: Split the JRC configuration from the DG Env configuration in order to add JRC specific characteristics and to prevent being hazed by the complexity of many different scenarios;
- October: 100m grid data collection, especially with a focus on urban land use classification;
- October support for simulation of user defined regions, and Land Use classifications.

Below is the project work-flow chart of the completed and of the yet foreseen tasks and deliverables of the project as well as timing. We do our best to follow this time-plan, but run the risk of encountering a delay of a few weeks due the experienced problems with the land-use data.

Table 5 Time schedule of project deliverables; M1-M12 denote the months since start of the project, shaded figures indicate the weeks in which products will be delivered.

Nr.	Deliverable	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
1	Kick off and revisions												
1.1	Minutes of kick-off meeting	1											
1.2	Revised work plan	1											
1.3	Revised provisional model description	1											
1.4	Model description		8										
2	Model development and initial runs												
2.1	Preliminary model delivery						26						
2.2	Initial version procedure documentation						26						
3	Model tuning and refinement												
3.1	Second version of model									36			
4	Definite version of the model												
4.1	Draft final version of model											46	
4.4	Draft final report											46	
5	Finalisation and documentation												
5.1	Final version model											48	
5.3	Final version report											48	
6	Project Management												
6.1	Monthly progress emails	4	8	13	17	21		30	34	39	43		
6.2	Interim technical report						26						
6.3	Final technical report											48	

The official starting date of the project is: November 7, 2008. This implies the following calendar dates for the main project deadlines:

- Initial model description to be delivered by December 26, 2008 (week 8);
- Interim technical report to be delivered by April 17, 2009 (week 24);

Final technical report to be delivered by October 2, 2009 (week 48).

Appendix 1 Preliminary model delivery

May 2nd Maarten Hilferink uploaded the the first Preliminary EuClueScanner modelling framework results. Below is a short account of the procedure to download this model version, a description of its main components and a discussion of further development plans.

To install and run the project follow the following steps:

- 1) Run <http://www.objectvision.nl/OutGoing/EuClueScanner/GeoDms556-SetupW32.exe> Info on this installation can be found at <http://www.objectvision.nl/geodms/> under the menu item Software -> Installation Instructions.
- 2) Download <http://www.objectvision.nl/OutGoing/EuClueScanner/EuScanner-2009-05-01.rar> and extract its contents to an application data folder; I will further refer to the extracted EuScanner project folder in that application data folder as %projDir%.
Note that EuScanner is a working title pending the search for a better name. Hereby I propose EuClueScanner. There are still a few Dutch related names here and there; they will be replaced later.
- 3) Start the GeoDmsGui.exe (which you probably installed in %ProgramFiles%/ObjectVision/GeoDms556) and open the configuration %projdir%/cfg/nll08.dms. Info on how to use the GeoDmsGui.exe can be found at <http://www.objectvision.nl/geodms/> under the menu item User Guide -> GeoDMS GUI.

When you request results, they will be calculated on demand. For this a CalcCache will be stored by default in C:\LocalData\EuScanner. If you want the several gigabytes to be stored elsewhere, define another folder for %LocalDataDir% by selecting Tools->Options from the main menu of the GeoDmsGui.exe and close and restart that program. More info on managing a CalcCache: <http://www.objectvision.nl/geodms/> under the menu item Modelling -> CalcCache -> How to work with the CalcCache. Info on the Declarative Model Script (the .dms files): look under the menu item Modelling.

Now about the EuClueScanner modeling framework:

- Implemented now are the 24 country specific cases as they were calculated for EuRuralis by Clue.exe for the B1 scenario.
- Data for those cases is now read from country and scenario specific folders: %projDir%/data/B1/XXXXX.
- The simulation model ClassicClueWrap instantiates DynaClueImpl which instantiates DynaClueTimeStep for each simulated year.
- DynaClueTimeStep allocates land use that maximizes the total transition potential according to the specified minimum claims and maximum restrictions.
- It further allows for caller-specified:
 - dynamic rules for the calculation of transition potentials (which are used by ClassicClueWrap to apply on dynamic neighbourhood enrichment, dynamic suitability factors, and to disallow certain transitions);
 - timestep output generation;
 - post processing (which is used by ClassicClueWrap to specify bottom-up rules for natural transitions).

There are now also European wide driver and transition allowance data, but I omitted them from the uploaded EuScanner.rar to reduce the total size and upload time since they aren't used yet.

Once you have opened the configuration %projdir%/cfg/nll08.dms you will see a TreeView on the left. The country specific Clue cases are found under:

/Cases/EuRuralis2/Cases/ CASENAME/ COUNTRYNAME/

They are instantiated by the calculation rule at /Cases/EuRuralis2/Cases which refers to:

- the parameter container /Cases/EuRuralis2/MetaData/Params; and
- the calculation scheme /RekenSchemas/ClassicClueWrap

To view a calculation result, click on, for example:

/Cases/EuRuralis2/Cases/B1/ITALY/Results/landuse/View10

Currently, all parameters and suitability factor weights are directly read from the parameter files in the Clue folders. Since only the country specific factor data for B1 are in the EuRuralis.rar, selecting an A2 case results to an error now; since all parameter files are available for A2, they will become available as soon as I start using the European wide factor data.

Under Cases/EuRuralis1 there are also two cases (Belgium/Luxembourg and France) which use additional calculation results from Clue.exe and for which the GOF measures are available; these will remain available for some time for regression test purposes but will be removed from the final version. An example of a GOF measure is:

/Cases/EuRuralis1/Cases/BelLux/DynaClue/TimeSteps/P2030/ResultingState/OutputGeneration/DiffCells (click on it to see which 63 cells are different from the Clue.exe results).

After installing lc100_1990.asc and lc100_2000.asc in %localProjDataDir%/JRC/ (not included in the provided EuRuralis.rar) you can view 100m data, click on

/Grondgebruik/JRC/LC-YYYY/COUNTRY/Jrc22Data

To view MetaInfo on available drivers: click on /MetaData/Factors

Known issues:

- EuScanner -> EuClueScanner
- Nll08.dms -> EuClueScanner.dms
- Grondgebruik -> LandUse
- ClueRegion "Baltic" refers to several Nuts0 regions. Since ClueRegions have been configured as a subset of Nuts0 regions, "Baltic" is now inaccessible.
- 35 Nuts0 regions were indicated as Clue Regions, but only 24 are available (exceptions are: the three Baltic states, Norway, Iceland, Turkey, FYROM, Serbia, Bosnia, Croatia, Switzerland)

Following steps before the workshop on the 26th of June may include:

- 15 may: connecting the cases to the European wide driver data (now only the current landuseClue18 data and Nuts0 data are taken from a European AsciiGrid) so that also the A2 scenario becomes available. These cases will become available under /Cases/EuRuralis3
- 30 may: link from the GTAP/Image model results to the regional demands
- more indicators (to be discussed with Peter and Eric)
- description of the final data folder structure and configuration files structure; some immutable large data folders will have to become available as separate downloads.

After the workshop I plan to:

- integrate the parameter files to create a European wide model for 1km grid allocation
- more indicators
- support for more scenario's.

Furthermore I will continue with the following JRC specific tasks:

- adaptation of the logistic regression functions for automated calibration based in lc1990 -> lc2000
- design of the Scenario/Case Definition tool and data ingestion procedures
- support for the simulation of user defined regions with a 100m grid based allocation model for the Jrc22 land use classification with user defined additional classes; these will become available under /Cases/JrcX

Appendix 2 Time reference Corine Land Cover data

The Corine Land Cover (CLC) data are based on satellite images from a variety of years (source <http://dataservice.eea.europa.eu/dataservice/>). The table below indicates these years for the 34 participating countries. CLC1990 data are not available for all countries. Please note that for some countries no CLC1990 data set exists although images were available. This relates to Finland for which the data quality was considered too poor and the UK. For the UK a CLC-change data set exists however.

Country	CLC1990		CLC2000		Comments
	start	end	start	end	
Albania	x	x	1995	1996	considered as CLC2000
Austria	1985	1986	1999	2001	
Belgium	1989	1990	1999	2000	
Bosnia and Herzegovina	x	x	1998	1998	considered as CLC2000
Bulgaria	1989	1992	2000	2001	
Croatia	1990	x	1999	2000	by downdating CLC2000
Cyprus	x	x	2000	2000	no CLC1990 available
Czech Republic	1989	1992	1999	2001	
Denmark	1989	1990	1999	2001	
Estonia	1993	1995	1999	2001	
Finland	1986	1994	1999	2002	no CLC1990 version 9/2007 available
France (Incl. Monaco)	1987	1994	1999	2001	
Germany	1989	1992	1999	2001	
Greece	1987	1991	2000	2001	
Hungary	1990	1992	2000	2000	
Ireland	1989	1990	2000	2001	
Italy (Incl. San Marino and the Vatican)	1990	1993	1999	2002	
Latvia	1994	1995	1999	2001	
Liechtenstein	x	x	2000	2000	no CLC1990 available
Lithuania	1994	1995	1999	2001	
Luxembourg	1991	1991	2000	2000	
Macedonia, FYROM	x	x	1995	1996	considered as CLC2000
Malta	x	x	2001	2001	no CLC1990 available
Montenegro	1988	1992	2000	2001	
The Netherlands	1986	1988	1999	2000	
Poland	1989	1992	1999	2001	
Portugal	1985	1987	1999	2002	
Romania	1989	1992	2000	2001	
Serbia (Excl. Kosovo)	1988	1992	2000	2001	
Slovak Republic	1989	1992	2000	2001	
Slovenia	1995	1996	1999	2000	
Spain	1984	1990	1999	2002	
Sweden	x	x	1999	2002	no CLC1990 available
United Kingdom	1989	1990	1999	2002	no CLC1990 version 9/2007 available

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